Near Real Time Applications for Maritime Situational Awareness

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Maritime Security Lab Neustrelitz

German Remote Sensing Data Center (DFD)

2016 Workshop on
Solutions for Maritime Situational Awareness
Helsinki, 12 February 2016

DLR

Presentation Outline

Background

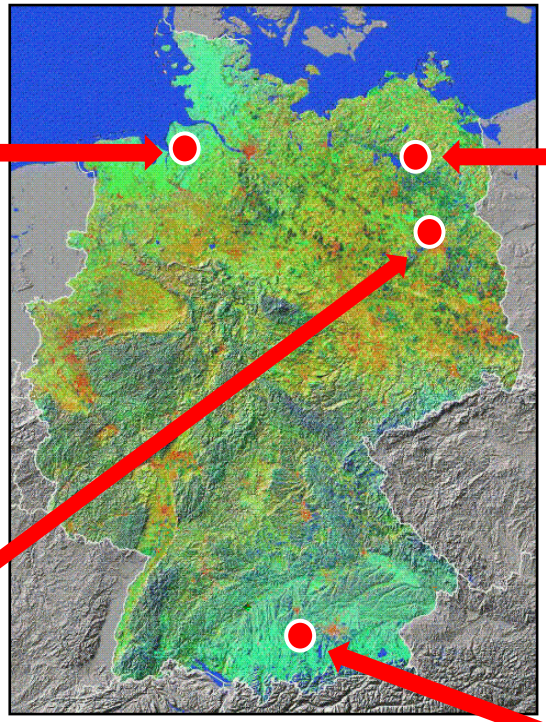
- Maritime Security Lab Neustrelitz
- Component of Service Chain

Application Status and Future Development

- Ship Detection
- Oil Detection
- Wind and Wave
- Iceberg Detection and Classification

Earth Observation Center – EOC

Bremen
Maritime Security Lab



Neustrelitz
National Ground Segment
Maritime Security Lab

Berlin

- Consists of the Remote Sensing Technology and the German Remote Sensing Data Center
- Appr. 350 employees at 4 sites
- Chairs at 2 university

Oberpfaffenhofen

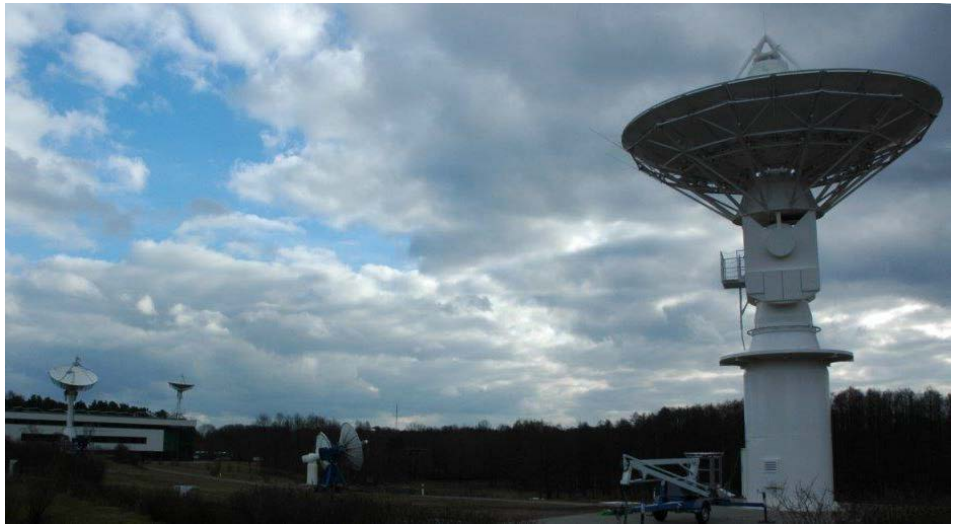
DLR

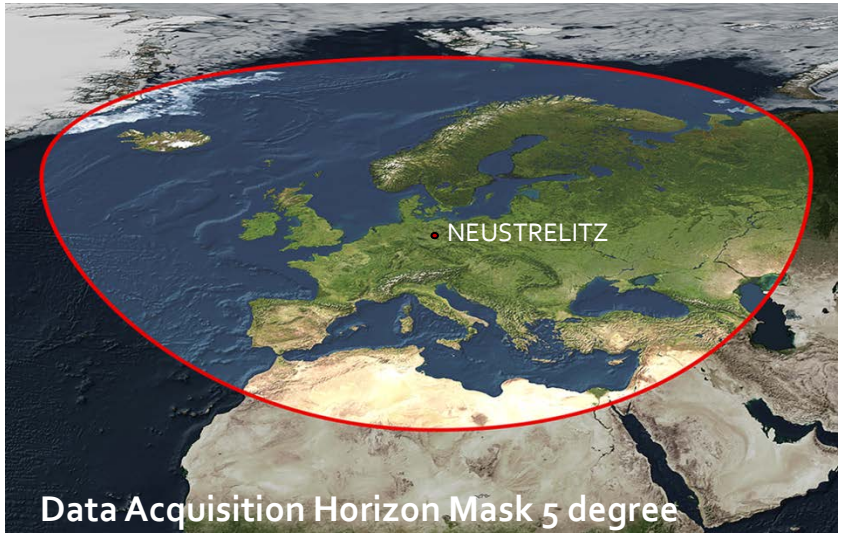
German Remote Sensing Data Center
Department: National Ground Segment

- Ground Stations
- Data Management
- Realtime Services
- Maritime Security Lab
- Calibration- and Validation Testsite DEMMIN

Ground Station and Processing Facility Neustrelitz

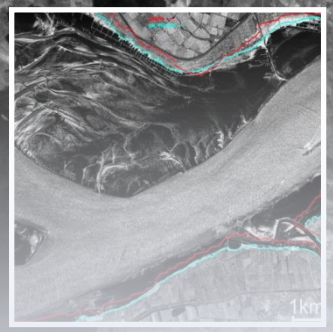
- Support of currently 12 different Satellite missions
- Main reception and processing facility for SAR Mission TerraSAR-X
- Collaborative Station for European Sentinel missions
- Radarsat-2 Regional Ground System for science purpose since Summer 2015



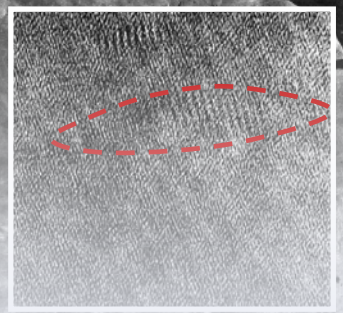


Synthetic Aperture Radar enable applications for following Products

Bathymetry

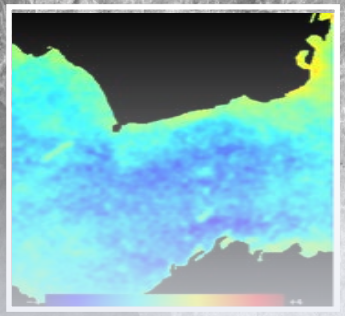


Land-Water Line

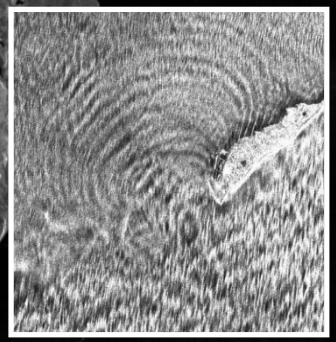


Wave groups & Forecast

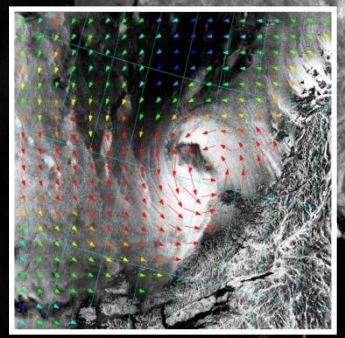
Wave breaking



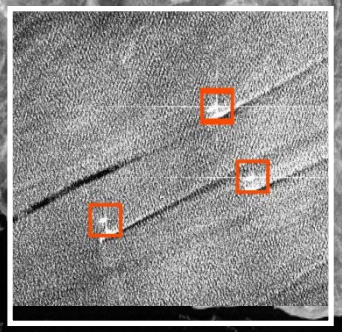
Surface Currents



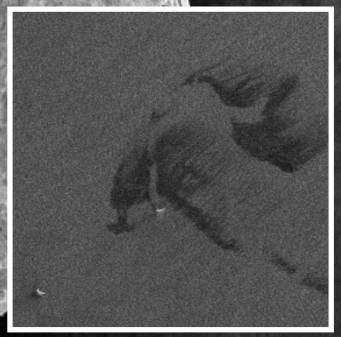
Sea State



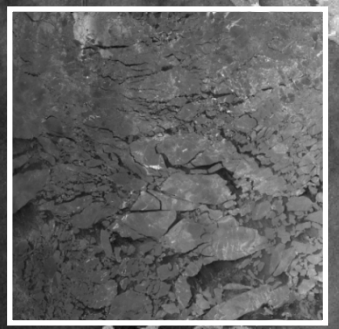
Wind



Ship- detection



Oil Spills

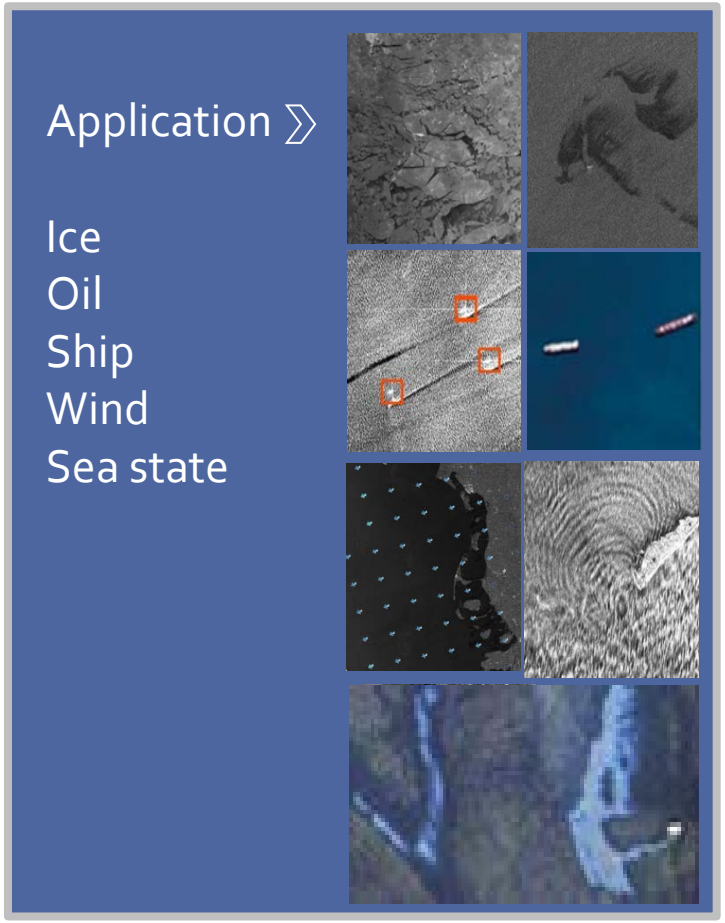


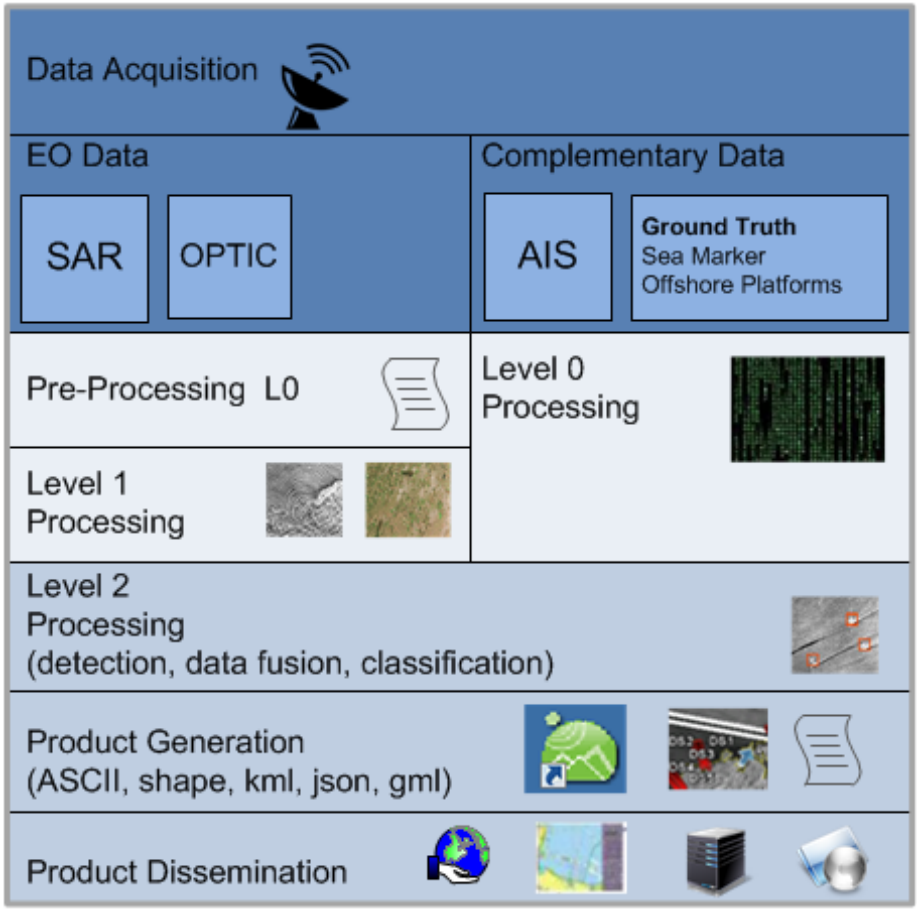
Iceberg-detection, Ice classification

Objective

Research and development of integrated applications enabling specific value added

Maritime Information Products for the Maritime Situational Awareness



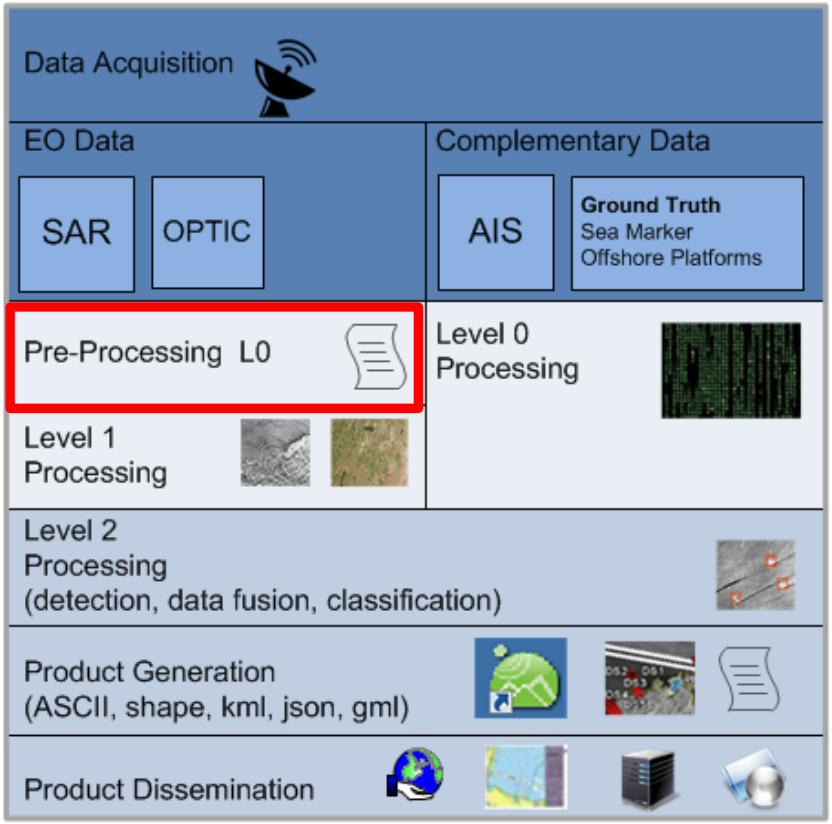


Objective

Research and development of integrated applications enabling specific value added **Maritime Information Products for the Maritime Situational Awareness**

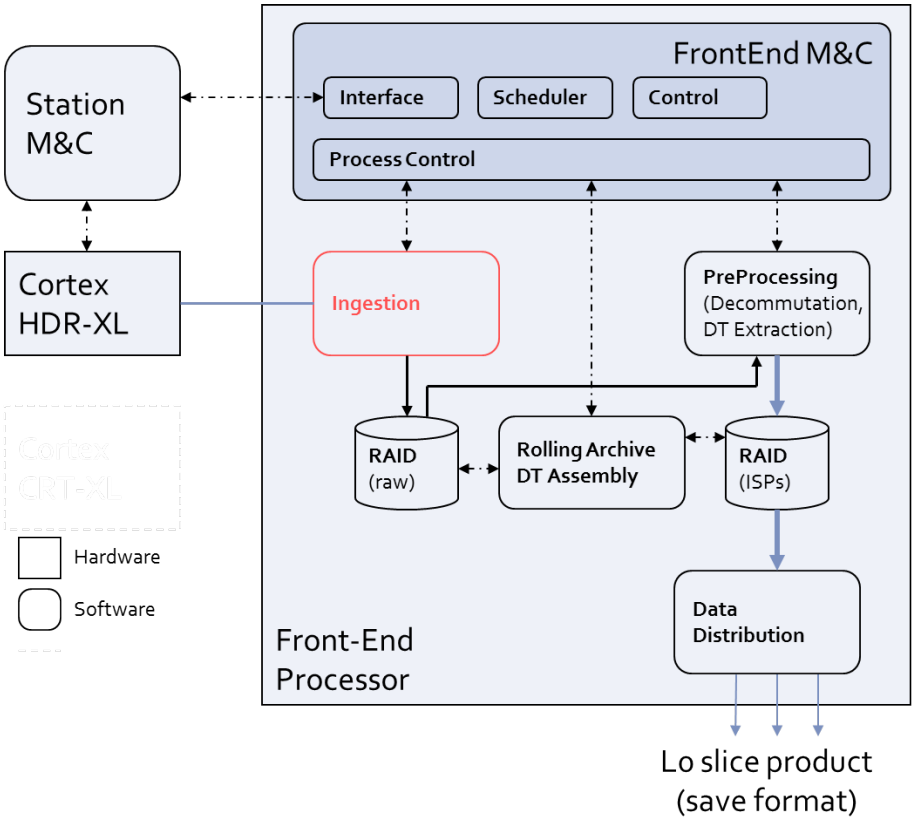
System engineering to enable…

- efficient use of the processing environment (parallel processing)
- operational use of research findings
- processing of different sensors and modes
- operational data fusion of different data sources like EO data and terrestrial AIS or AIS from space
- product development
- dissemination systems development



L0 Processing
NRT – Front End Processor (Sentinel-1)

- Implementation of Ingest and Process Units
- GUI for Monitoring and Control (M&C)
- Integration into Stations M&C System
- Provide data quality information
- Handling of Station Metadata
- Development of device driver (CORTEX demodulator)
- Product generation
  - Lo processing (slicing) and distribution



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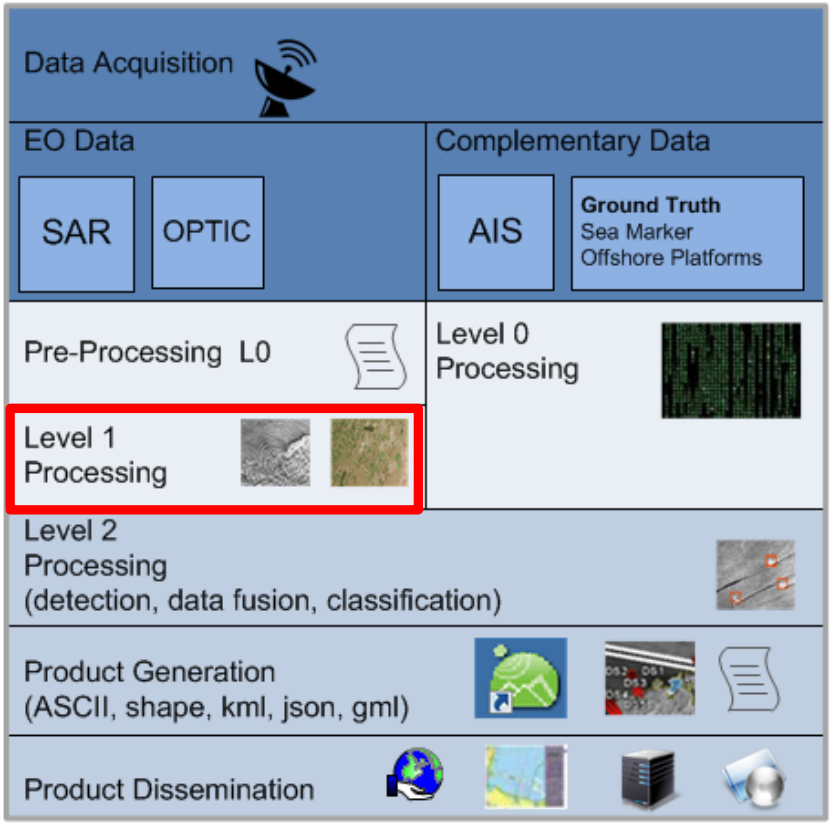
Level 1 Processing

DLR Processing System Management System (PSM)

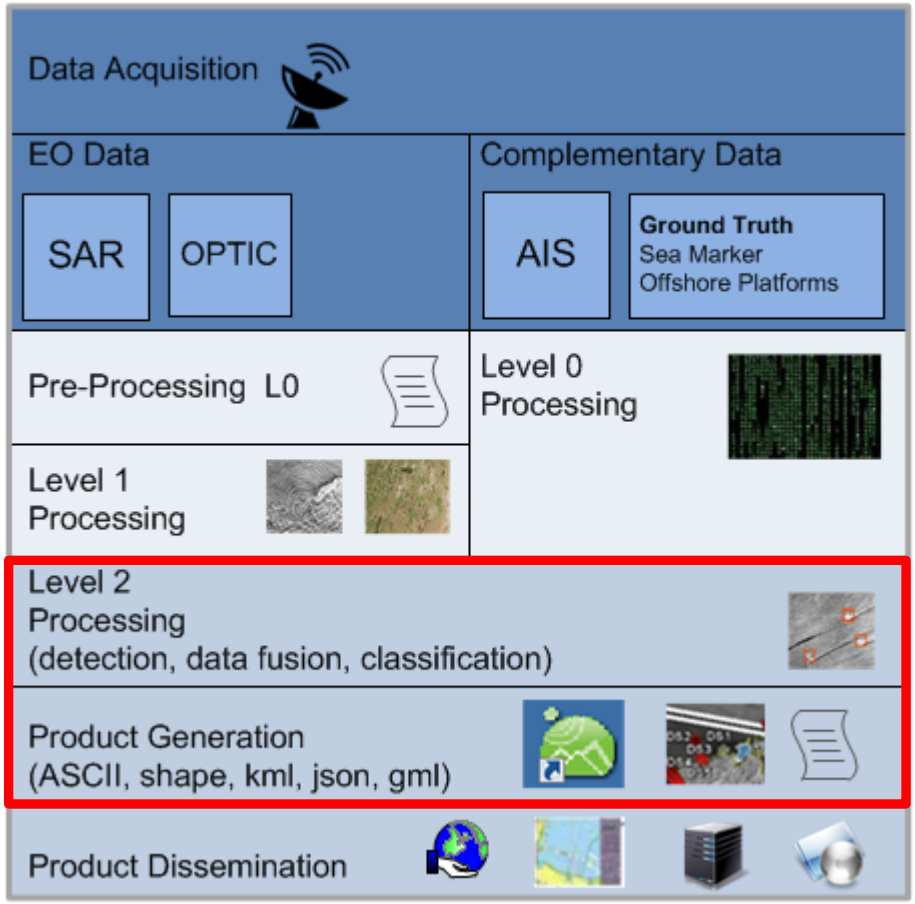
- Request or data driven workflow
- Product handling and cache management
- Development of Control System based on Processing System Management (PSM)
  - TerraSAR-X
  - Sentinel-1
- Integration of CORE Processor
  - TMSP (TerraSAR-X)
  - ESA IPF (Sentinel-1)



Level 2 Processing and Product Generation

DLR Processing System Management System (PSM)

- Rule based
  - L2 - value adding processing (SAR, Optic)
  - Data fusion
  - Operator Interface
- Product generation
  - L1b product (EOPO, EMSA)
  - L2 product (shape, netCDF,KMZ)
- Product dissemination
  - ftp/ sftp
  - GeoServer
  - e-Mail



Product Dissemination

DLR Processing System Management System (PSM)

- Request or data driven workflow
- Product handling and cache management
- Rule based
  - L2 - value adding processing (SAR, Optic)
  - Data fusion
  - Operator Interface
- Product generation
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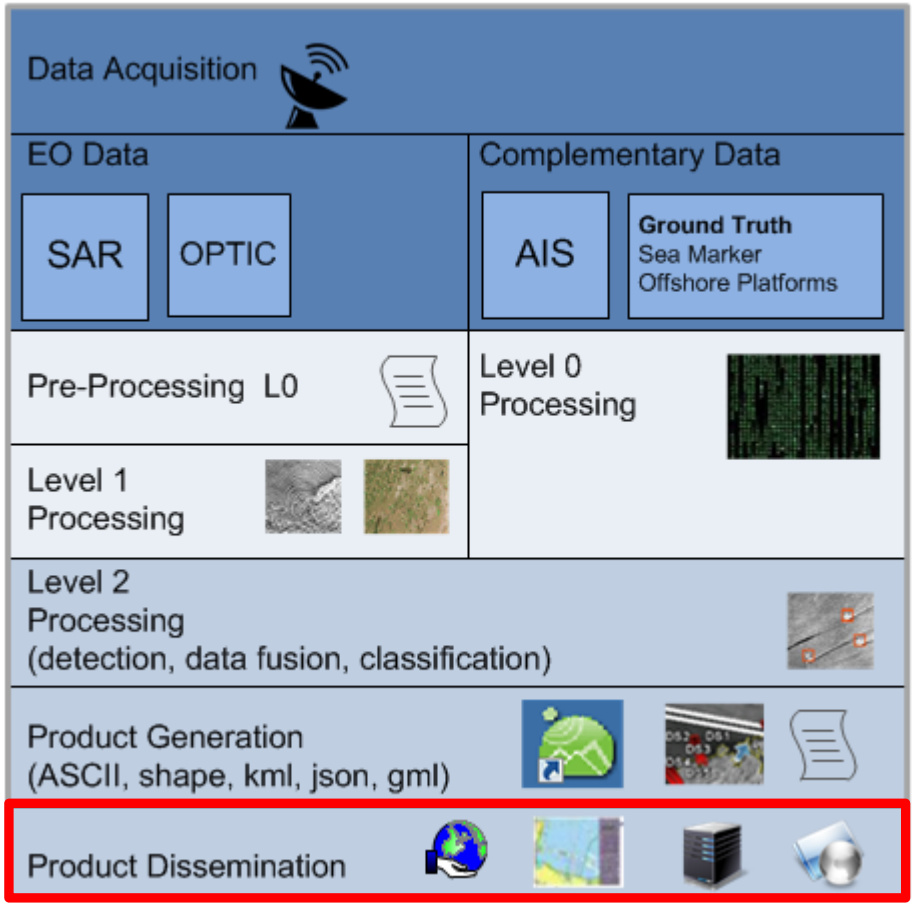
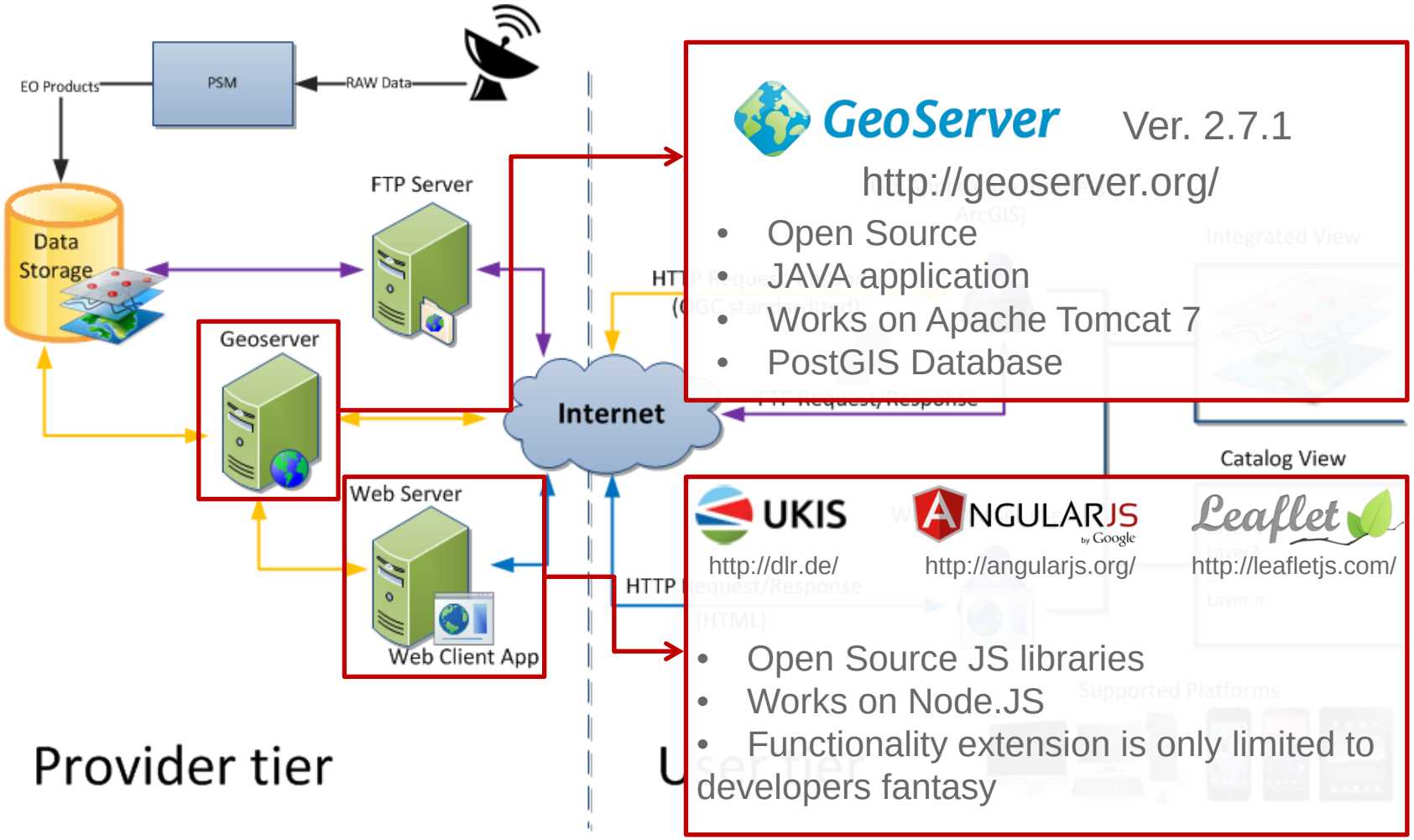
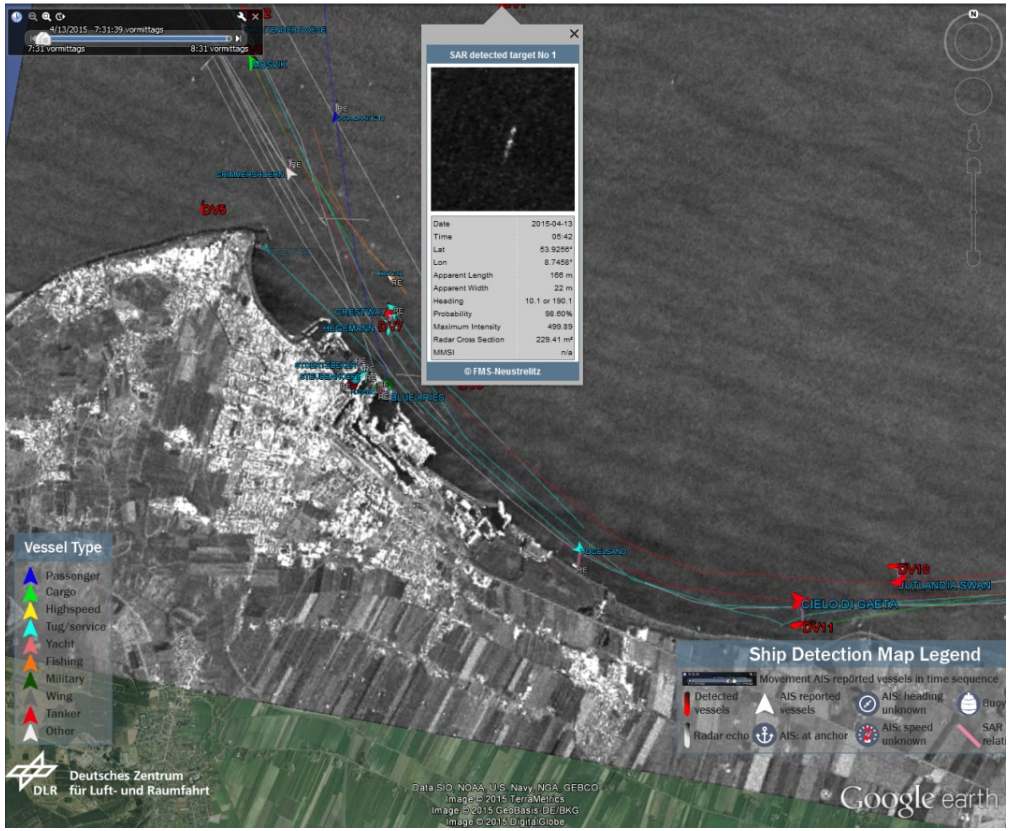


Web Mapping Service: FMS Neustrelitz



Ship- Detection Application



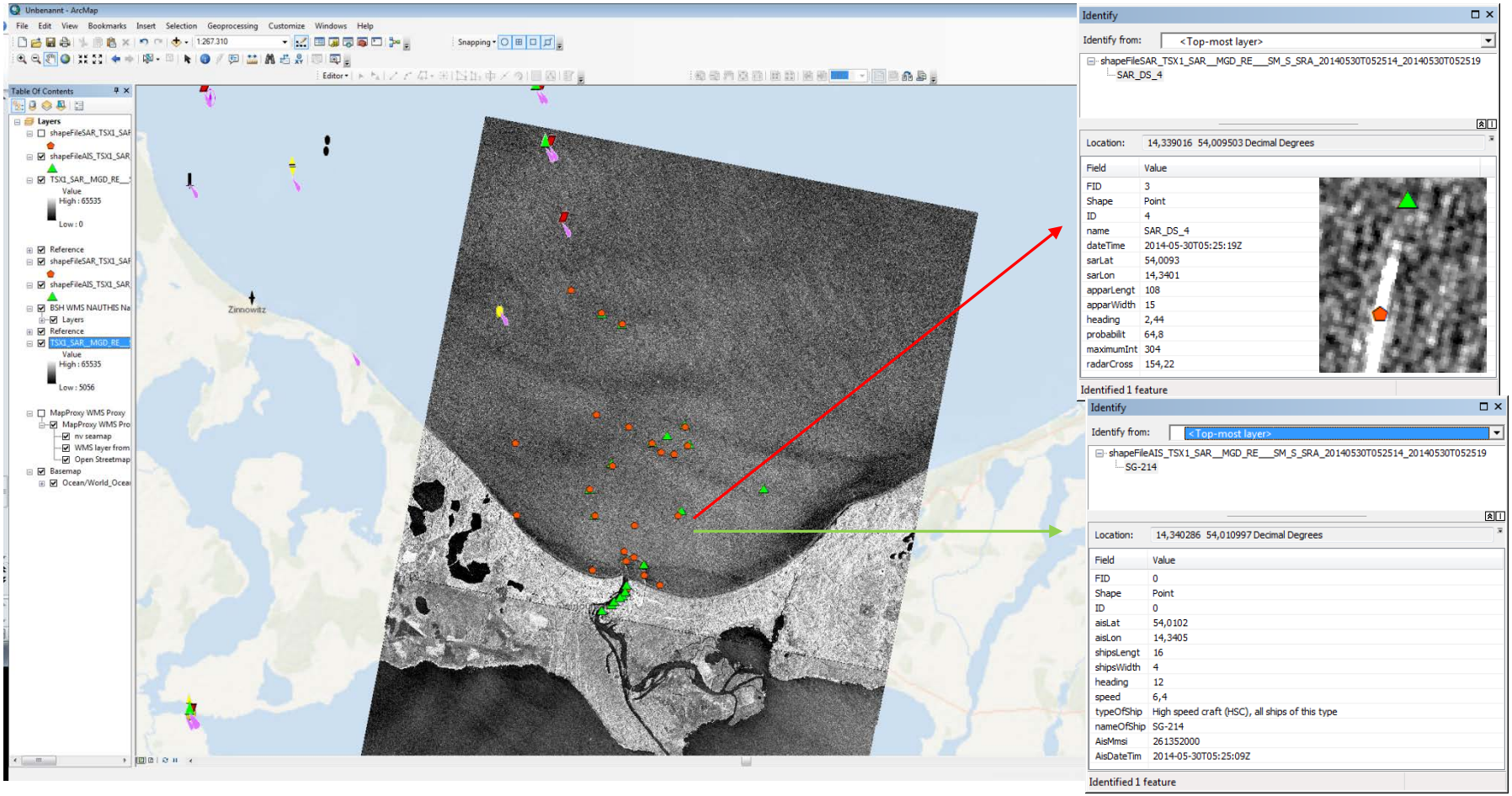
Available for:

- TerraSAR-X, TanDEM-X
- CosmoSkyMed
- Radarsat-2
- Sentinel-1

Value added products

- **SAR/ AIS merged products** (in case of available AIS Data)
- ASCII ; KMZ, GML; DER (EMSA);
- ESRI shape; json;
- GeoTIFF (MRES_L1b; HRES_L1B)

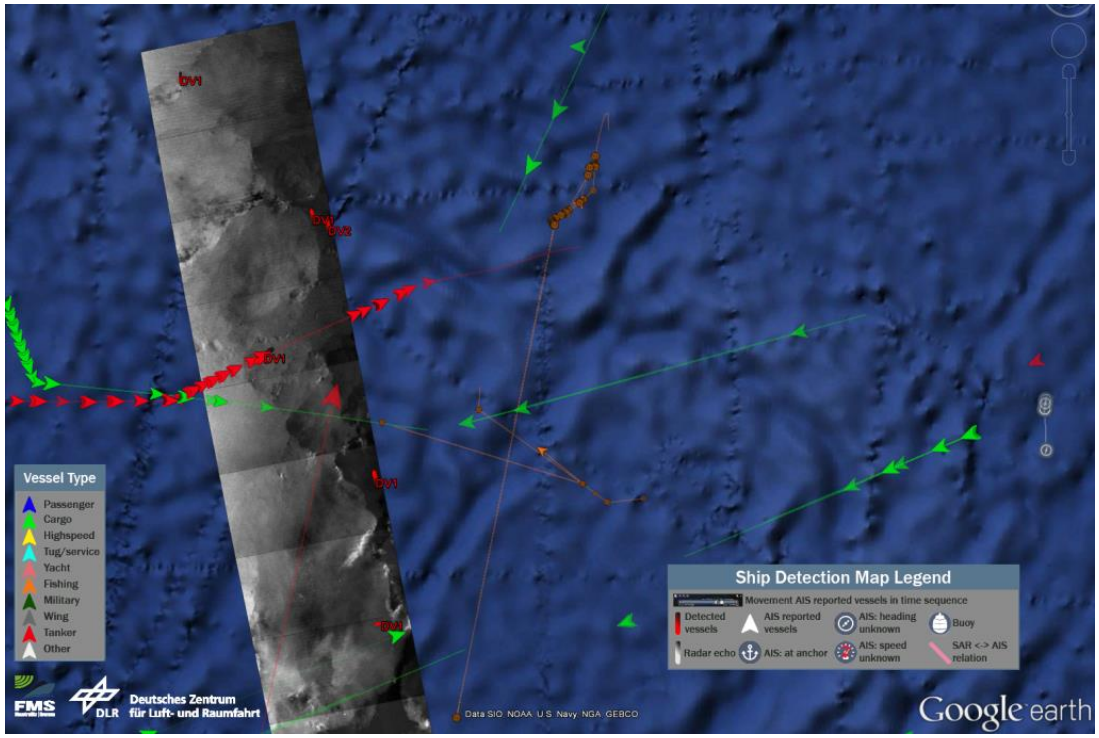
Ship- Detection Application



Polish Coast Guard BUNDESPOLIZEI esa MARISS European Maritime Security Services

DLR

Joint Research Center JRC
Project PMAR-MASE 2015



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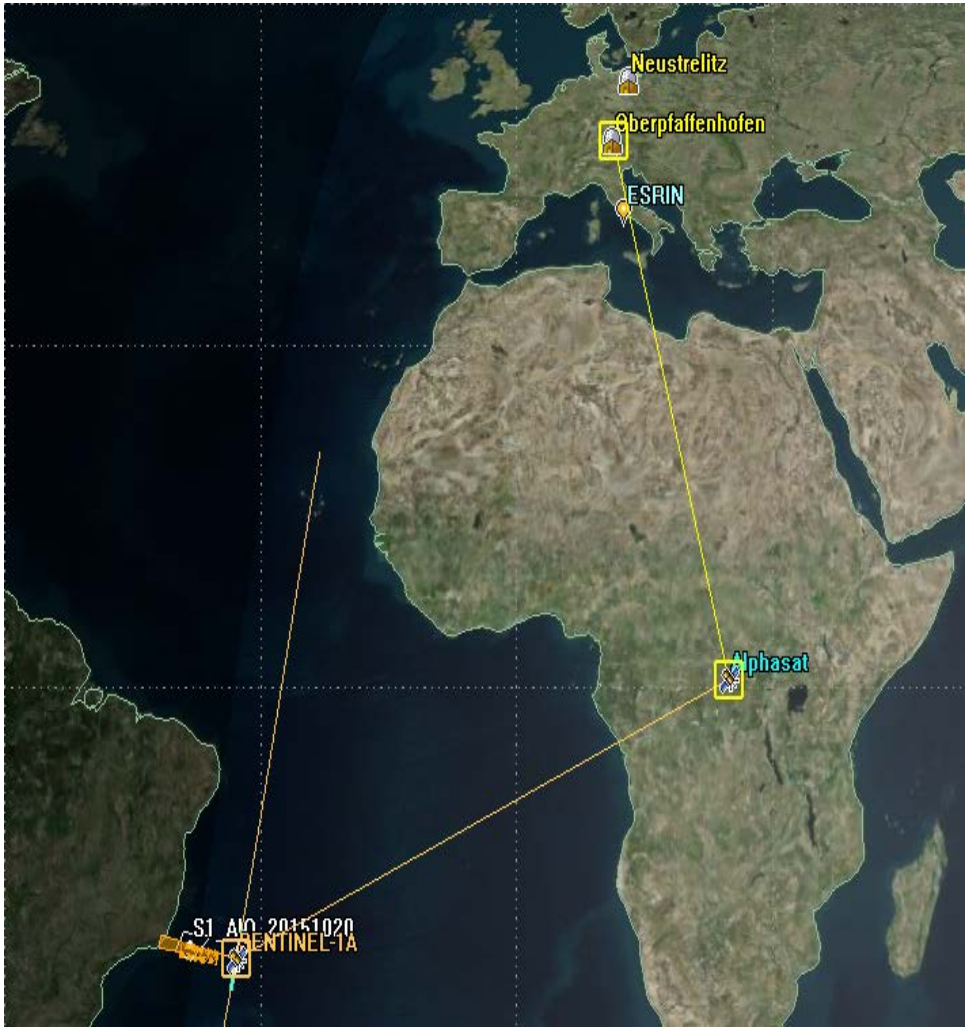
Project support during August and September2015:

- Acquisition planning for TerraSAR-X based on the Region of Interest, defined by the project
- SAR/AIS Ship detection processing AIS Data provided by JRC, (Data Exchange Agreement JRC/DLR)

Application Example

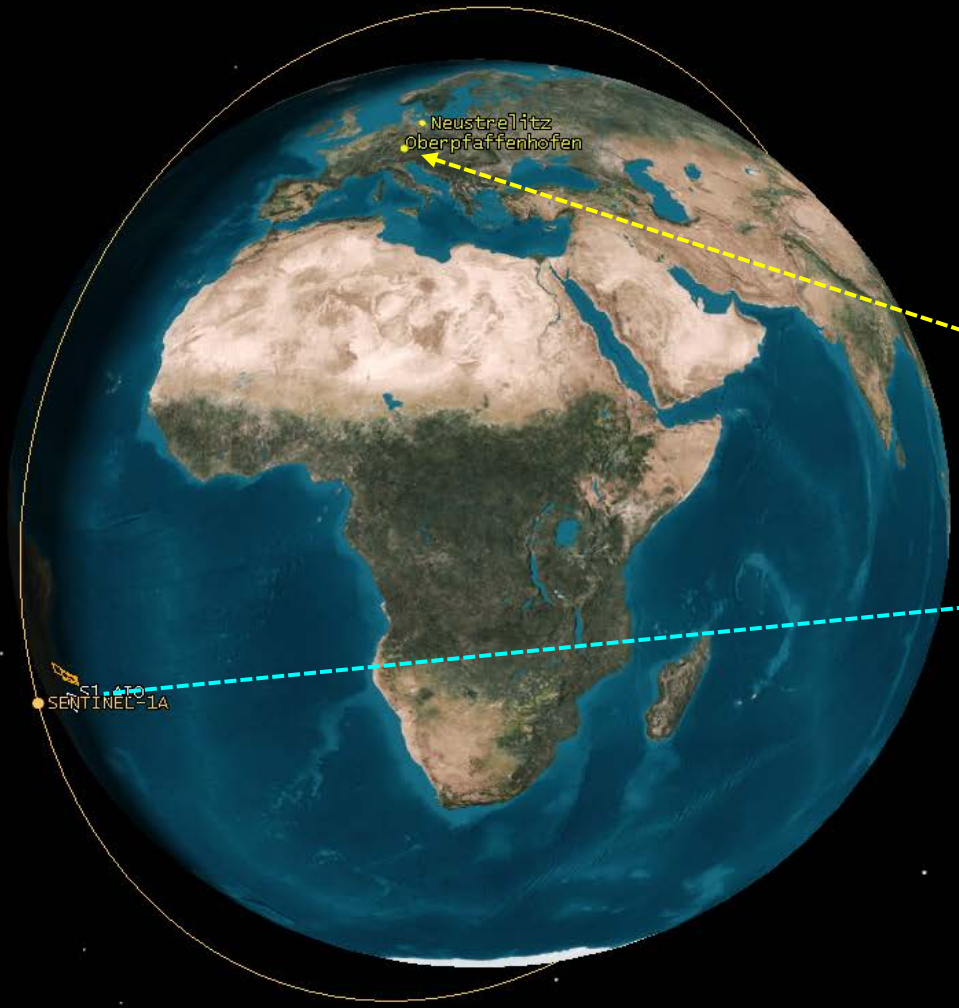


Sentinel-1 Acquisition and Downlink – Alphasat TDP-1 Test

Partners involved:

- ESA ESRIN
- ESA ESTEC
- ESA ESOC
- TESAT
- Eutelsat
- Airbus
- DLR Space Management
- DLR Earth Observation Center
  - Oberpfaffenhofen
  - Neustrelitz

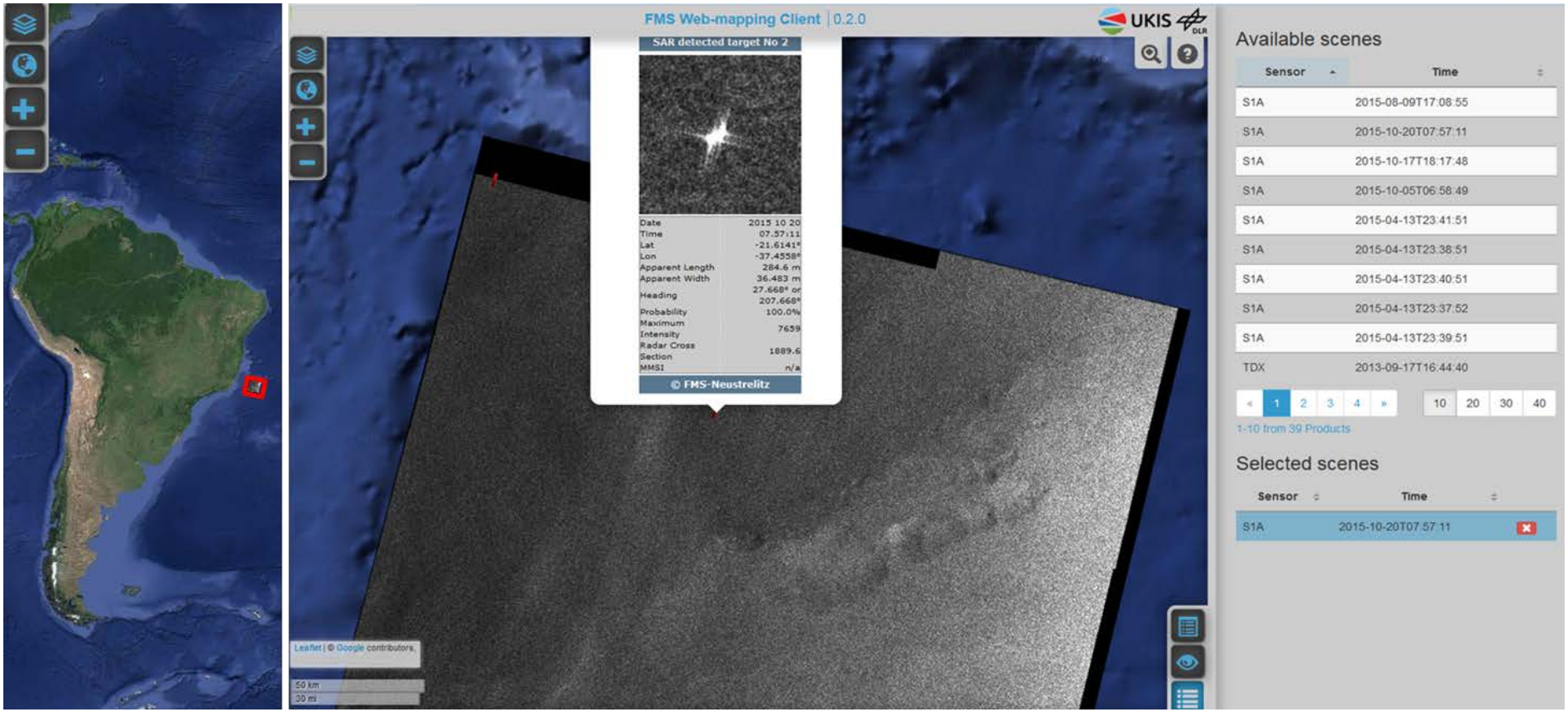
LCT-Link and data reception



Alphasat

- Reception in Oberpfaffenhofen via Alphasat Ka- Band Antenna
- L0 Processing in Oberpfaffenhofen
- Transfer to Neustrelitz and QRT processing and automated ship detection
- End-to-End time: 18 min (further optimization possible)

Alphasat NRT Demo:
L2 ship detection product at Google Earth



Optical Satellite Services for EMSA (OpSSERVE)

partner: EUSI (contractor) and DLR (subcontractor)

➢ Provision of Vessel- and Activity- detection service

- **optical satellite imagery (< 1m)**
  - Worldview-1;Wordview-2 (0.50m)

NRT Delivery ≤1 hour*	NRT Delivery ≤3 hours*

  - GeoEye-1;EROS-B; Ikonos; Quickbird;Worldview1; Worldview-2

Non NRT Delivery ≤24 hours*	Archive Delivery ≥24 hours*

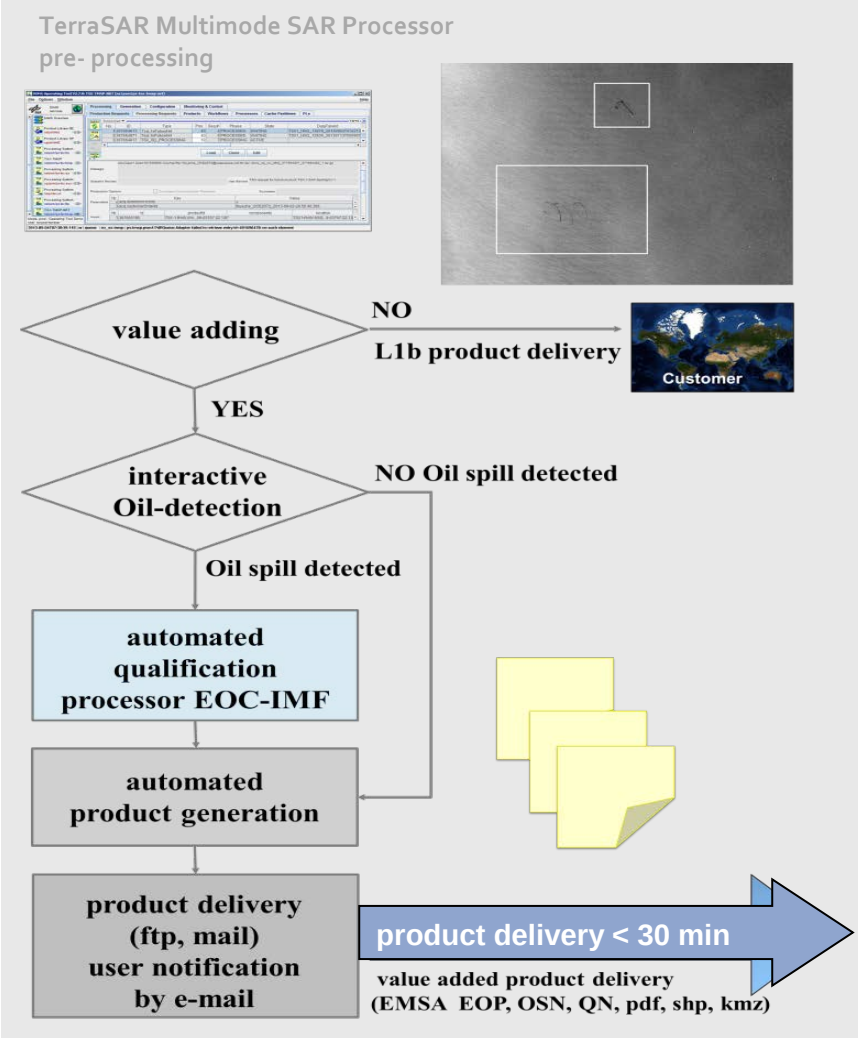
– **derived information** at sea and coast :
  – **Vessels, mainly < 15m**
  – **Vessel activities**

WorldView-2, Mogadishu, Somalia, 28.08.2012

skiffs

skiffs on the beach

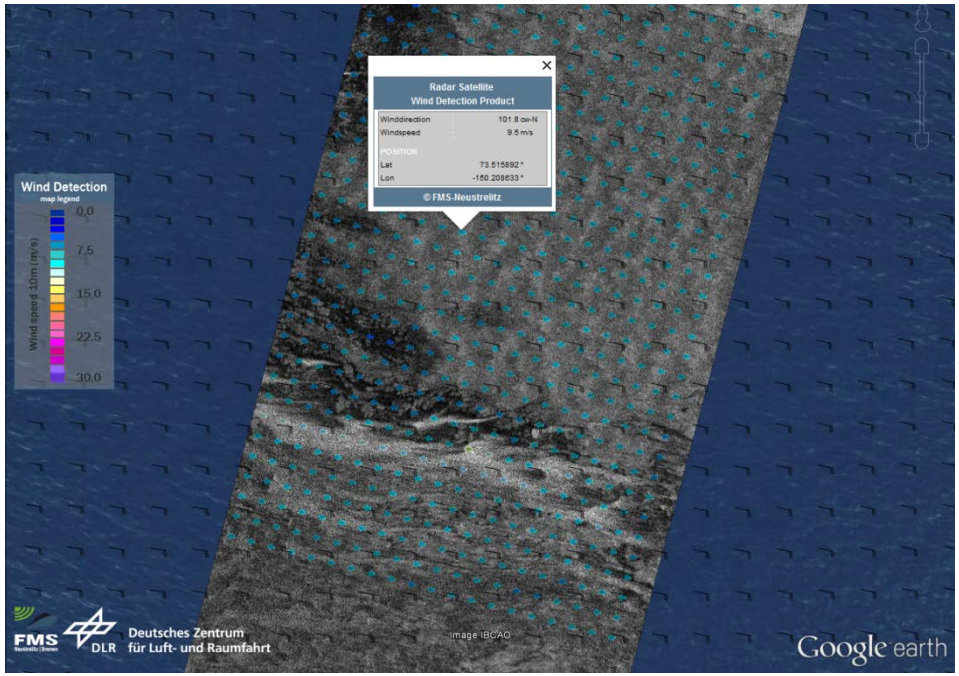
Oil Spill Detection Application



Control system implemented using the DLR Processing System Management (PSM) part of the Data Information Management System (DIMS)

- Interactive processing
- Operator interface via Virtual Network Computing (VNC)
- Automated qualification processor, Core function is the qualification algorithm developed by the Maritime Security Lab Bremen based on Neural Network (S. Singha et al.)
- Automated product delivery within 30 minutes

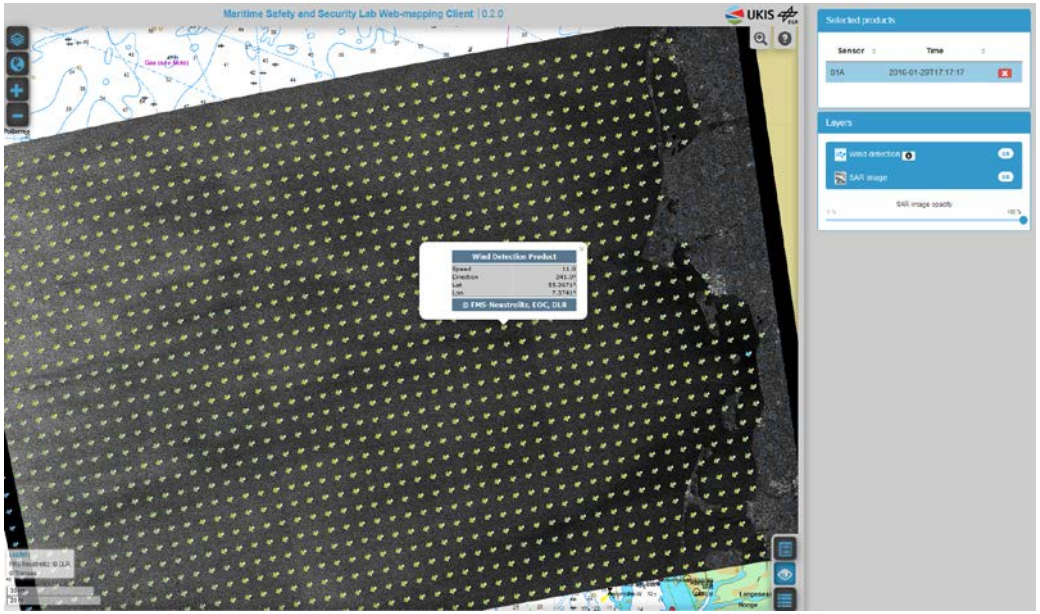
Application for Wind field products based on TerraSAR-X



The wind forecast and the Level 1 quicklook product in the background is overplayed by the DLR SAR WIND product (rectangle) derived from the TerraSAR-X StripMap image

- Core function is the XMOD-2 algorithm developed by the Maritime Security Lab Bremen to derive wind speed and direction (Jacobsen et al., 2013)
- Forecast model is implemented to provide wind direction , the netCDF output is generated, containing the wind direction and intensity (WD10)
- Level 2 Produktformate
  - ASCII
  - netCDF
  - Google (KMZ)
  - png, wld, png.aux.xml
  - ESRI Shape Layer Files (shape)

Application for Wind field products based on Sentinel-1



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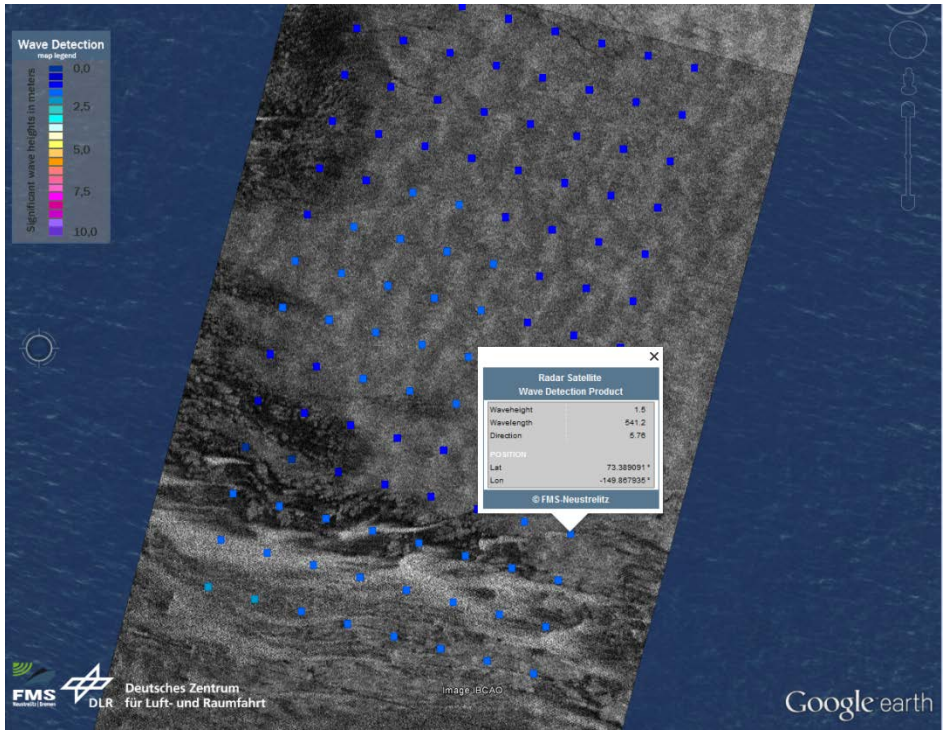
The Level 1 quicklook product (background) is overplayed by the DLR SAR WIND product (rectangle) derived from the Sentinel-1 image

- Core function is the CMOD-2 algorithm developed by the Maritime Security Lab Bremen to derive wind speed and direction
(Jacobsen et al., 2013)

- Forecast model is implemented to provide wind direction , the netCDF output is generated, containing the wind direction and intensity (WD10)

- Level 2 Produktformate
  - ASCII
  - netCDF
  - Google (KMZ)
  - png, wld, png.aux.xml
  - ESRI Shape Layer Files (shape)

Application for Wave products based on Mission TerraSAR-X



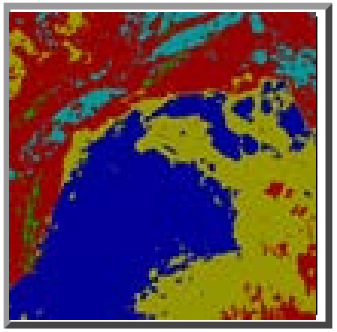
The L1 quicklook product in the background is overplayed by the DLR SAR WAVE product (rectangle) derived from the TerraSAR-X StripMap image

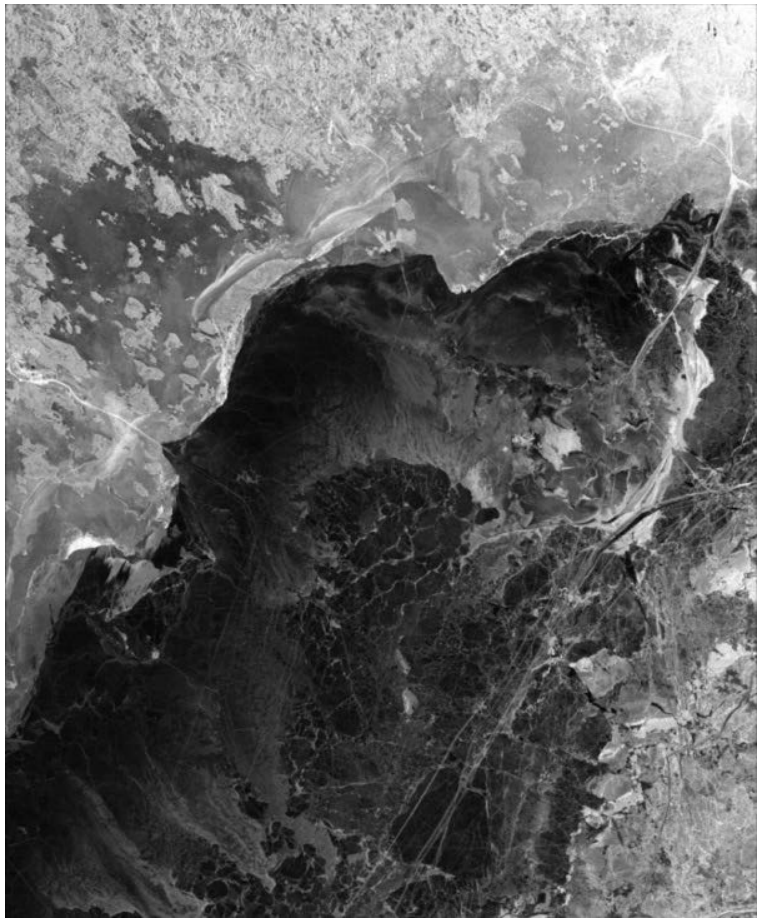
- new XWAVE-2algorithm developed by the Maritime Security Lab Bremen to derive wave height and wave length (Pleskachevsky et al., 2015)
- Level 2 Produktformate
  - ASCII
  - netCDF
  - Google (KMZ)
  - GIS, png, wld, png.aux.xml
  - ESRI Shape Layer Files (shape)

Ice Classification

- Currently being developed by the Maritime Security_Lab Bremen (Ressel et al., IEEE, TGARS)

- Planned value added products based on TeaarSAR-X (DualPol)
  - ASCII ; png, KMZ,
  - ESRI shape;
  - ECDIS (S411) Ice Chart





Conclusion

- Remote sensing SAR images are more and more in use to support maritime surveillance.
  - Near real time capabilities are amongst others the main requirements for such services.
  - NRT application for SAR processing enables automated fast processing of large volumes of data and information delivery within ~10 to 20 minutes of image acquisition.
- Main tasks for **Solutions for Maritime Situational Awareness** (not complete)
  - Use of multiple information sources to enable integrated solution of maritime picture
  - Data sharing, data fusion and big data handling,
  - High availability of fully automated processing chains
  - Product and interface standardization

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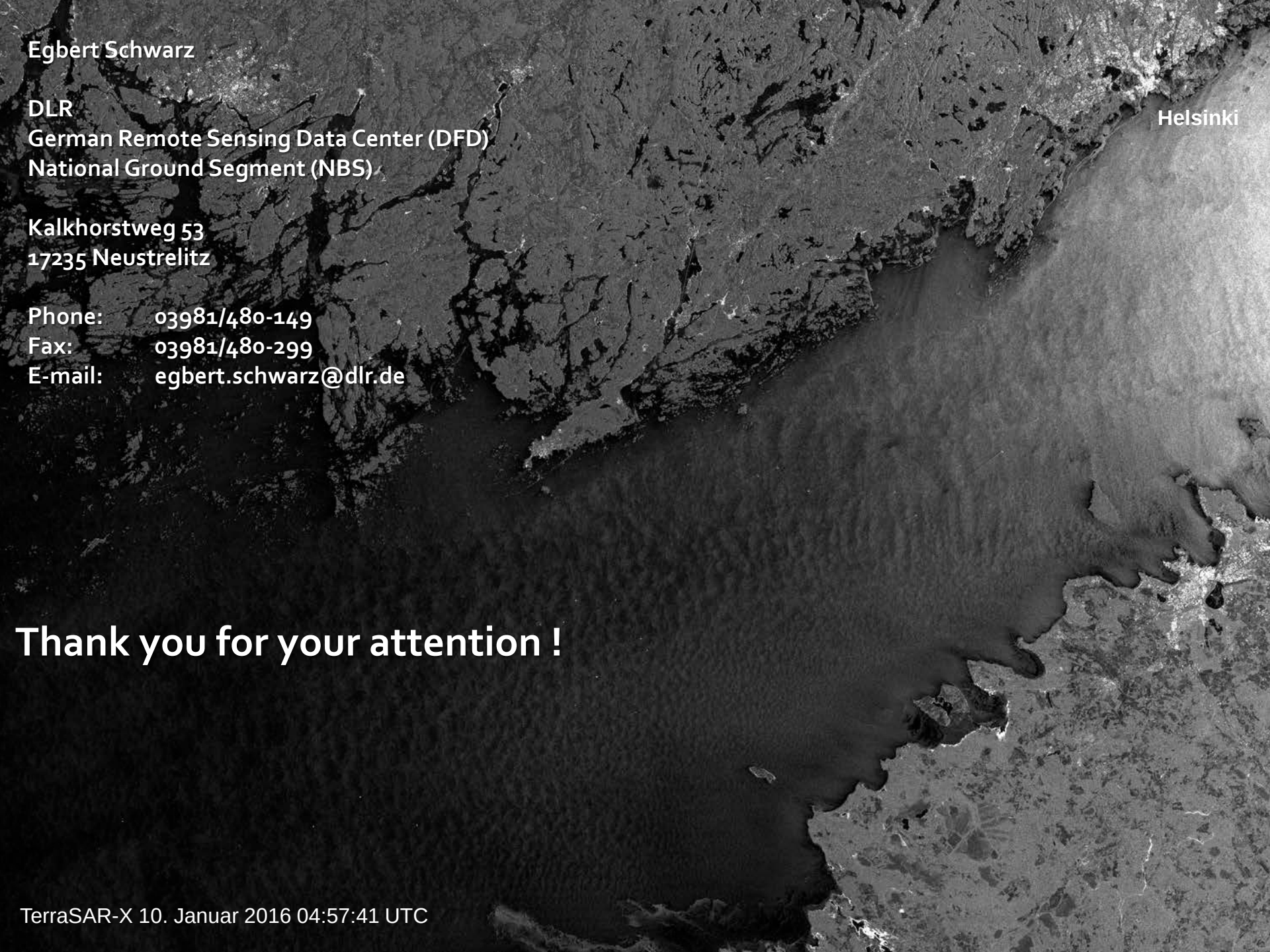

Thank you for your attention !

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